BIRD

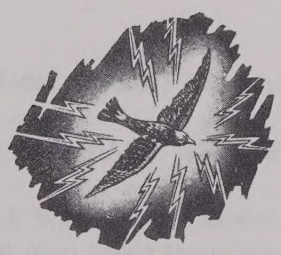
INSTRUCTION MANUAL for

TERMALINE®
model 6254
Radio Frequency Wattmeter

OPERATING AND MAINTENANCE MANUAL

for

RADIO FREQUENCY MILLIWATTMETER



BIRD ELECTRONIC CORPORATION
Cleveland, Ohio

OPERATING AND MAINTENANCE MANUAL

for

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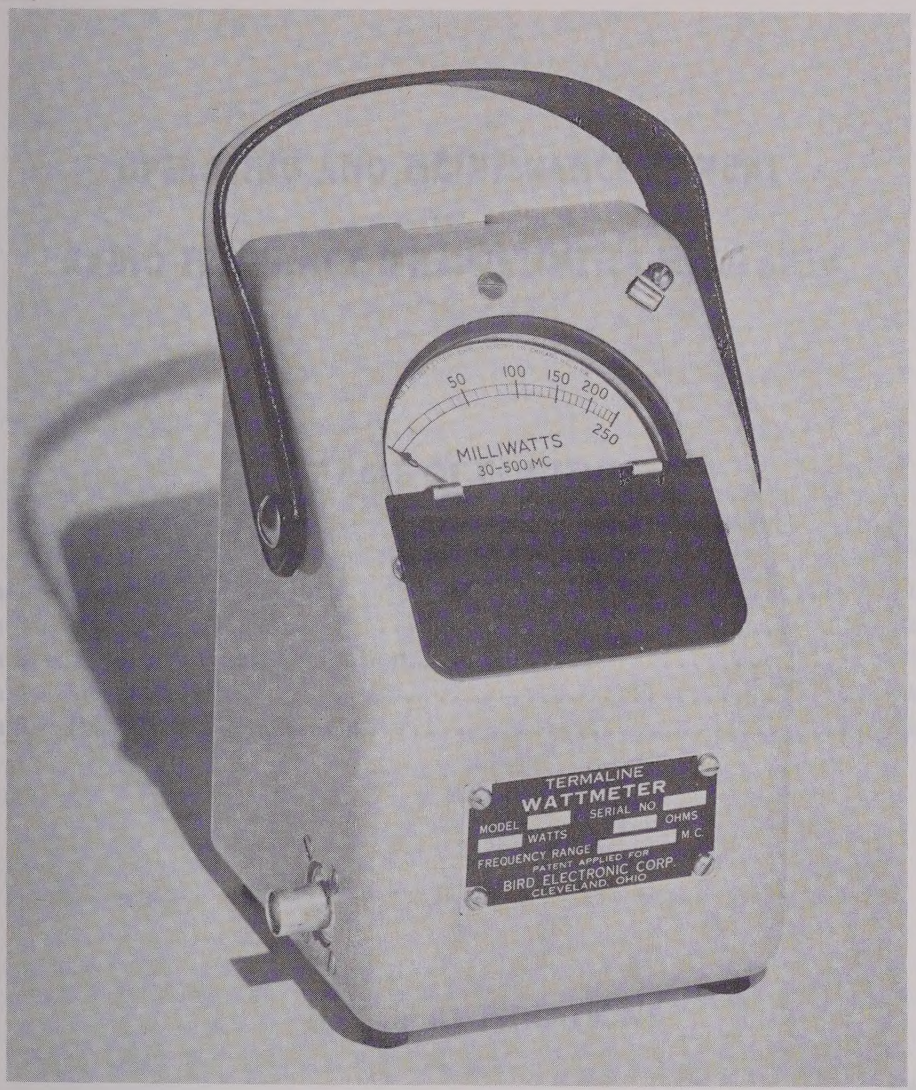

Fig. 1-1
Model 6254 RF Wattmeter

SUMMARY OF BASIC SPECIFICATIONS

Type:	RF Wattmeter, Model 6254
Circuit:	50 ohm input impedance (TERMALINE)
Termination VSWR:	1.00 to 1.10 in specified frequency range
Type of Modulation:	CW or AM type signals, not designed for use on pulsed power, similar to radar.
Frequency Range:	30 to 500 mc per second
Power Range:	Up to one watt full scale
Power Accuracy:	±5% full scale
Connectors:	BNC (female) input jack
Weight:	2.2 pounds (equipment only) 2.5 pounds (packed for shipment)

OPERATING AND MAINTENANCE MANUAL
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RADIO FREQUENCY MILLIWATTMETER Model 6254

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Section 1 - GENERAL

1. SCOPE OF MANUAL

This instruction book covers the description, theory, operation and maintenance of the Model 6254 RF Wattmeter (Milliwattmeter), Fig. 1-1.

2. PURPOSE AND APPLICATION

The Model 6254 is designed to measure the power output, and facilitate the tuning of transmitters of low power output (up to one watt). The basic specifications are listed on the summary sheet at the front of this manual. It may be used as a dummy load of 50.0 ohms characteristic impedance for radio frequency power as above.

3. DESCRIPTION

The essentials of the Model 6254 Radio Frequency Wattmeter equipment are relatively simple. It consists of two primary elements as follows: rf load resistor and detector unit; and a direct-reading microammeter (in watts).

The energy of the transmitter is fed thru rf cable into the Load Resistor E-601 (thru BNC Jack J-601).

The load-resistor unit is mounted inside the lower left-hand side wall of the Wattmeter Housing A-601. Its output is thru dc Jack J-602 on the top of the load resistor block, and is fed thru Cable W-602 directly into the Microammeter M-601. The microammeter, of a sealed, ruggedized type and for which the detector units are specifically calibrated, is scaled to read dc current directly in rf milliwatts. The Housing A-601 (and hinged dial flap) furnish additional physical protection for the microammeter.

The back of the Housing A-601 has an access cover permanently hinged to the bottom edge of the box. This cover is fastened by a beryllium copper spring clasp at the top. Open the cover by pulling out firmly at the finger groove on the top of the housing. At the base of the housing is a special spring bracket for holding the spare crystal (see Maintenance Section). Across the top of the housing is a Strap 0-601 for carrying convenience.

TABLE 1-1 EQUIPMENT DESCRIPTION

	Model	Overall Dimensions			Weight (pounds)
		h	w	d	
1 RF Wattmeter	6254	5-7/8	4-1/4	3-5/8	2.2
1 Spare Crystal	G7C	3/4 lg.	9/32 d	-	-
1 Operating Manual	-	9	6	1/16	-

Section 2 - THEORY

1. GENERAL

A traditional method of measuring transmitter power at low frequencies utilizes the basic relationship $W=E^2/R$, illustrated in circuit diagram, Fig. 2-1. E is the voltage drop across a power dissipating resistor R. Accuracy in this method requires that the voltmeter be connected directly across the resistor terminals as well as the obvious necessity that both the voltmeter and resistor be accurate and corrected for operating frequency.

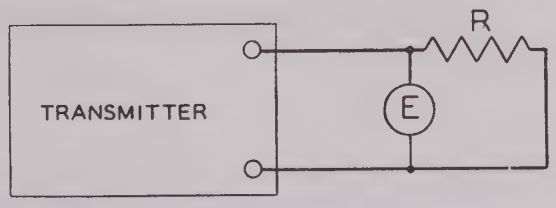

Fig. 2-1
Circuit diagram-E^2/R method of power measurements

The resistor and terminals in the Model 6254 are designed to have a constant characteristic impedance of 50.0 ohms over a wide frequency range.

2. VOLTS vs. WATTS

The voltmeter of circuit in Fig. 2-1 may be equipped with a direct reading scale in watts, for use with a definite load resistance R. This scale would be linear in watts if the voltmeter were of the square law type similar to thermocouple or iron vane meters.

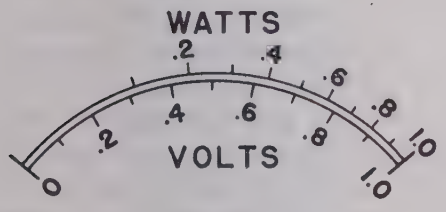

Fig. 2-2
Square law scale, watts vs. volts

When the voltmeter is a linear type, the watt scale will be as shown in Fig. 2-2. This compares equivalent voltage and power scales for a hypothetical 50.0 ohm, 1 watt, 1 volt instrument. Half full-scale deflection is obtained at one-fourth full scale power. The voltmeter used in the Model 6254 is approximately linear and the scale is of the type shown in Fig. 2-2.

3. VOLTMETER CIRCUIT, Fig. 2-3.

The adjustable tap on R_1 (load resistor) serves as a voltage divider across the input voltage of resistor R_1. The sample rf voltage so produced is fed to the germanium diode rectifier CR_1. Functioning as a half-wave rectifier, CR_1 charges capacitor C_1 to the peak rf voltage impressed on it by the R_1 voltage tap. The capacitance of C_1 is sufficiently low to maintain the proper

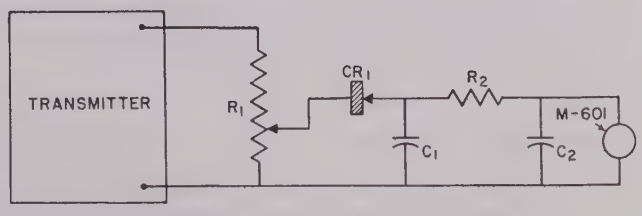

Fig. 2-3
Schematic circuit diagram, Model 6254

time constant for the 30-500 mc frequency range of this equipment. Resistor R_2 and microammeter M-601 form a dc voltmeter circuit used to measure the dc voltage developed across charge capacitor C_1. The capacitor C_2 is of relatively large value with a minimum of residual inductance. C_2 is an rf bypass for the microammeter, protecting against the effect of any stray rf currents. The entire circuitry is carefully shielded for protection against induced currents caused by external rf fields.

Section 3 - INSTALLATION & OPERATION

1. INSTALLATION

The RF Wattmeter Model 6254 is a portable instrument with no provision for fixed mounting, and may be used in any desired location. The housing should be used in upright position wherever possible. See Fig. 3-1 for dimensional outline of wattmeter.

2. OPERATION

No switching, calibrating or tuning of the Model 6254 Wattmeter is required. Before applying power, check zero position of meter pointer. If required, adjust pointer by inserting small screwdriver in hole underneath meter flap and slightly twisting screw to move the pointer to zero position. Now turn on transmitter power and pull down meter flap on slant face. Read rf output directly in milliwatts. The accuracy of the instrument ±5% applies over the specified frequency range. For interpretation of greater accuracy the typical instrument measurements deviate slightly as follows: Approximately 3% low at 30 mc, even calibration at 250 mc, and approximately 5% high at 500 mc.

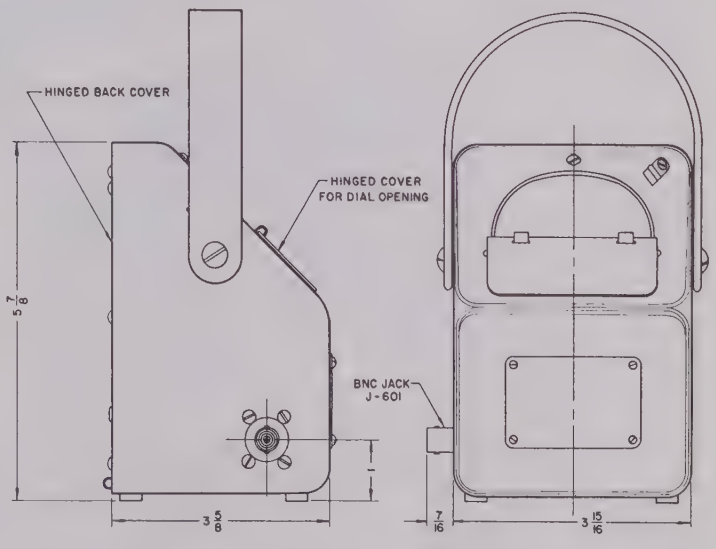

Fig. 3-1
Outline drawing, Model 6254 Wattmeter

When the meter M-601 is attached to the load resistor, take care not to subject the unit to more than twice the full-scale power as indicated by the meter, i.e., for a 250 mw scale, not more than 500 mw, as injury to the meter may result. Also, be careful not to subject the load resistor to rf power in excess of 2.0 watts for an extended period, as damage to the crystal may result.

Section 4 - MAINTENANCE

1. GENERAL INSTRUCTIONS

The simplicity of this equipment makes its care and treatment relatively limited. DO NOT DROP THE WATTMETER. A bad drop or hard blow might upset the delicate mechanism of the microammeter or disturb the calibration of the pick-up and detector circuit. The equipment should generally be kept clean, and the dc connections tight. The clamping nuts on the two dc plugs P-602 on cable W-602 should be checked from time to time, making sure that the connections are sound. To improve the contact, swing the body of the plug back and forth a few times before retightening the nut.

The connectors, particularly the BNC plugs and jacks, should be kept covered as much as practicable. Do not leave these connectors around in dusty or dirty places. If the insides of the connectors become dirty, clean carefully with Inhibisol or its equivalent, or trichlorethylene on a cotton swab stick. Clean all contact faces and exposed areas. Ventilate working area. For protection of the equipment, the back cover of the housing and meter dial flap should be kept closed at all times. The symbol identification and location of all replaceable parts are illustrated in Fig. 4-1.

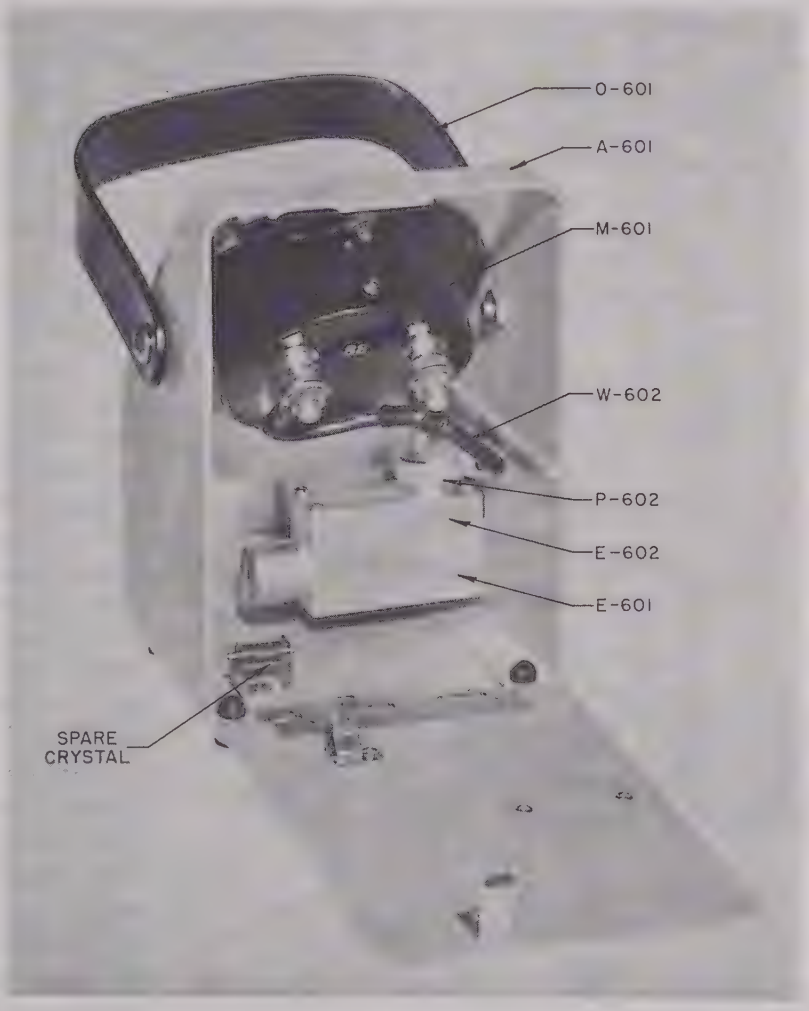

Fig. 4-1
Parts Identification Photograph

2. CRYSTAL DIODE AND LOAD RESISTOR

If the meter readings become irregular or questionable, the crystal may be faulty. Check the installed crystal for uniformity of results against the spare furnished with the equipment. These two crystals are G7C germanium diode rectifiers assigned specifically as a pair to each respective wattmeter. Neither should be placed or used in any other equipment. Activities having more than one Model 6254 Wattmeter must be especially careful to avoid mixups of crystals between units. Large errors in measurement may result when unassigned crystals are used. The spare crystals may be removed from the holder by gently pushing out the spring fingers of the holder.

To replace the crystal, remove all cable connections from the load resistor (RF Section) E-601, and with a small screwdriver unscrew the four #4 flat-head screws from around the BNC connector on the outside of the housing. This releases the load resistor, which is removed from the housing. Again with the screwdriver, take out the four #4 fillister head machine screws situated on the top side of the resistor housing cover E-602. The cover may now be lifted off, exposing the detector and calibrating circuitry of the load resistor unit. Do not tamper with setting of the pickup arm at the rear end of the load resistor. This will spoil the calibration, and the unit will have to be replaced or returned for recalibration.

To change crystal, insert the flat side of a small screwdriver under crystal terminal (large end of crystal, next to identifying band) outside of lug, see Fig. 4-2, and lift up gently to snap crystal clear of lug. Push other end out sidewise in same manner or pull terminal backward thru lug. Insert replacement G7C by reversing the foregoing procedure, making sure that the crystal is replaced in the direction shown in Fig. 4-2. The hole layout insures that the cover may be fastened back only in the correct direction. Before securing cover E-602 check and feel to make certain that the bent contact spring at the inside of the dc jack is in correct position per Fig. 4-2 and is making good contact with the button at the center of the by-pass capacitor. If contact pressure is insufficient, pull the tab down slightly, watching carefully to keep the spring in its proper location.

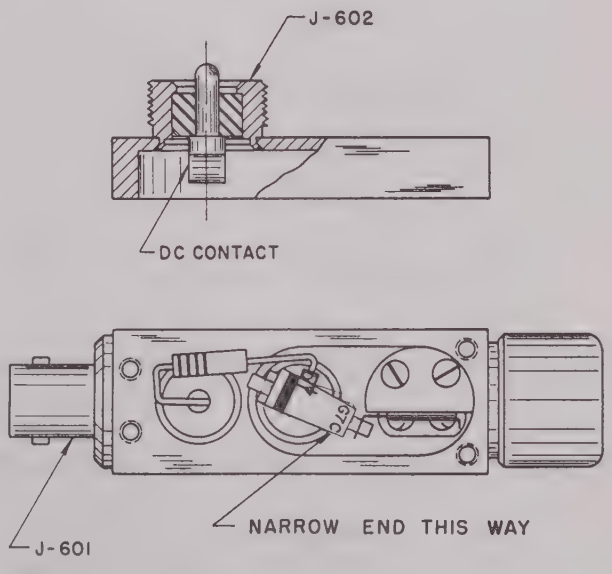

Fig. 4-2
Voltmeter Block E-601 and Cover E-602

The other portions of the circuitry in the load resistor unit should not be changed or disturbed. These parts are assembled in a practically permanent manner, with special techniques and equipment. If all the other causes of fault (as outlined in Trouble Shooting, Table 4-1) have been investigated and the readings still do not show expected response after change of crystal, the entire load resistor E-601 will have to be replaced.

Reassemble parts by reversing procedure outlined at beginning of this paragraph. Be sure to tighten down the dc plug firmly.

3. DC CIRCUIT CABLE

If erratic or no readings are obtained, the dc cables and connectors should be removed and checked. Use a megger and ohmmeter to test dc cable W-602 for shorts or discontinuity. If the cable needs replacement, or connectors have to be refitted, proceed as follows:

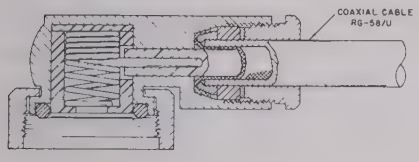

Fig. 4-3
Connector Plug P-602

Fig. 4-3 shows construction of the dc plugs P-602. Fig. 4-4 shows proper service of RG-58/U cable for these plugs. To remove cable from this plug unscrew the bushing and pull cable out. The center conductor of the cable makes tight contact between turns of the coil spring when assembled.

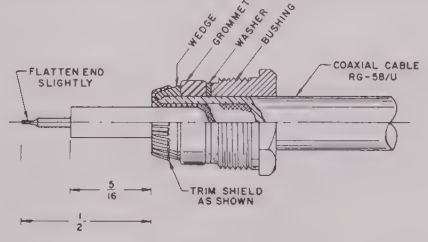

Fig. 4-4
Service for Connector Plug

Assembly of the RG-58/U cable to dc plug P-602 is as follows:

(1) Slip the bushing, washer, and grommet over end of cable.
(2) Remove outer insulation 9/16 inch from end.
(3) Slip collar over shielding (unbraided).
(4) Fold back braids and trim as illustrated, Fig. 4-4.
(5) Remove inside insulation to dimension shown.
(6) Flatten end of center conductor to sharp chisel edge, push into dc plug P-602, aligning edge with turns of coil spring.
(7) Push in grommet and washer and screw bushing down snugly.

If cables check good and an open circuit is still suspected, the spring contact on base of dc connector or resistor housing cover E-602 should be checked for contact or pickup button, see Fig. 4-2 above.

4. CABLE AND WATTMETER CHECK

Assuming a good load resistor, and dc connections all checked OK, then the rf power cable should also be checked for continuity; and perhaps verified by test against a substitute cable having UG-88/U plugs. The simplest test in the event of uncertainty of the condition of a wattmeter is to compare the equipment against the results obtained on another Model 6254 RF Wattmeter.

5. MICROAMMETER MAINTENANCE

If no readings are obtained, it is likely that the meter M-601 is burned out, and consequently must be replaced. It may be tested by the following procedure:

CAUTION

DC Meter Tests - Testing of the meter should be attempted only by one familiar with circuitry and instruments for testing sensitive dc microammeters because of the danger of damaging it in unsuitable circuits. Test the meter as a microammeter in series with a low voltage battery, variable resistor and an external dc microammeter with an accuracy of $\pm$1%. Full scale current should be 30 microamperes $\pm$2%.

M-601 is a sensitive microammeter. Do not attempt to check it with an ohmmeter. Do not tamper with fastening nuts on back of case or attempt to repair its internal mechanism.

If the meter pointer becomes unseated, it may be possible to restore it by carefully tapping or jiggling to get the pointer pivot back in its socket. If this is impossible, the meter will have to be replaced. Please note that M-601 meters are so scaled that they may be used in the Model 6254 with any good load resistor E-601, but that a crystal and spare crystal may be used only with assigned load unit. Meters are easy to change by removing dc plug connection and unscrewing the three #6-32 flat head screw and nut assemblies from the front face of the meter housing.

6. TABLE 4-1. TROUBLE SHOOTING CHART

Defect	Possible Causes	Remedy
A. No indication	1. No radio frequency power.	1. Check transmitter, switch on, refer to operating instructions for equipment used.
	2. Burned out crystal diode rectifier.	2. Replace with spare crystal. Sec. 4, Par. 2.
	3. Faulty dc cable.	3a. Check contacts of dc connectors P-602. Sec. 4, Par. 3.
		b. Check dc cable W-602 and connectors for continuity or short circuit. Sec. 4, Par. 3.
	4. Meter M-601 damaged or burned out.	4. Replace meter. Sec. 4, Par. 5.
	5. No contact, or fault in dc jack J-602 on cover E-602	5. Check and repair or replace. Sec. 4, Par. 2.
	6. Load resistor E-601 burned out or faulty.	6. Replace load resistor (RF Section) E-601 entirely. Sec. 4, Par. 2. Model 43 THRULINE Wattmeter.
B. Intermittent or inconsistent meter readings	1. Faulty rf cable.	1. Check rf cable with or by comparison with another cable into Model 6254 Wattmeter. Sec. 4, Par. 4.
	2. Sticky or defective meter M-601.	2. Test meter and replace if defective. Sec. 4, Par. 5.
	3. Faulty crystal diode.	3. Check against spare crystal. Sec. 4, Par. 2.
	4. Faulty load resistor unit E-601.	4. Replace unit. Sec. 4, Par. 2.
C. Readings apparently incorrect.	1. Same as above items B. 1-4.	1. Same as above items B. 1-4.
	2. High VSWR on load.	2. Test load resistor E-601 with slotted line or with THRULINE Wattmeter.

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